

## Specification

Title of the Invention

5       Structure for mounting a solid-state imaging device

Background of the Invention

The present invention relates to a structure for  
10     mounting a solid-state imaging device such as a CCD (Charge  
Coupled Device) on a digital image capturing apparatus such  
as a digital camera.

Recently, a digital camera is used instead of a  
conventional camera which employs a silver-salt film for  
15     recording a captured optical image. In the digital camera,  
an optical image is captured by the imaging device and  
converted to digital image data so as to be recorded in an  
digital storage device such as a built-in memory or a  
detachable card-type memory.

20     When the imaging device is built in a camera, the  
imaging device is first soldered on a glass-epoxy circuit  
board, and the circuit board carrying the imaging device is  
then mounted on an optical unit. Please note that, in this  
specification, the "optical unit" is defined as an unit  
25     carrying a lens assembly, an infrared cutting filter and so

on, and a photographing optical system of a digital camera is constituted by mounting a circuit board carrying the imaging device on the optical unit.

In the meantime, a solid-state imaging device having 5 more than 2 million pixels has recently been put in practical use. In such a solid-state imaging device, the size of one pixel is so small that it becomes necessary for the imaging device to be mounted on the optical unit with very high positioning accuracy. That is, in order to obtain 10 precise image data, the light receiving surface of the imaging device must align with the focusing surface of the photographing optical system with high accuracy. If the light receiving surface of the imaging device is tilted with respect to and/or displaced from the focusing surface 15 of the photographing optical system, it becomes difficult to obtain precise data at the respective pixels.

With the above-explained conventional mounting structure, however, the positioning accuracy required for the imaging device of high pixel resolution can hardly be 20 obtained, due to the uneven thickness of the solder layer with which the imaging device is adhered to the circuit board and/or to the inherent warp of the glass-epoxy circuit board itself.

There have been various other structures for mounting 25 a solid-state imaging device on an optical unit, with which,

however, the imaging device can hardly be mounted on the optical unit with the required positioning accuracy and/or with efficient workability.

## 5 Summary of the Invention

It is therefore an object of the present invention to provide an improved structure for mounting a solid-state imaging device capable of mounting an imaging device with high positioning accuracy required in case of the imaging device of high pixel resolution as well as with efficient workability.

For the above purpose, in accordance with the present invention, there is provided a structure for mounting a solid-state imaging device, including:

a metal plate having a flat surface, a backside surface opposite to the flat surface, a projected surface projected by a predetermined height from the flat surface, the projected surface being parallel to the flat surface, and at least one opening formed on the projected surface and accessible through the backside surface;

the solid-state imaging device having a front surface for receiving light and a back surface, the imaging device being secured to the metal plate by means of adhesive applied at least to a corner edge portion formed by the

inner circumferential surface of the at-least-one opening of the metal plate and the back surface of the imaging device when said imaging device contacts the projected surface of the metal plate; and

5       fixing members for fixing the metal plate carrying the imaging device thereon onto the optical unit.

With the above constituted structure, as the metal plate carrying the imaging device with high positioning accuracy is to be mounted onto the optical unit, tilting 10 and/or floating of the imaging device caused due to soldering in the conventional structure can be avoided, and mounting of the imaging device on the optical unit with high positioning accuracy can be performed easily with efficient workability.

15       The structure may further comprise a circuit board electrically connected to the imaging device, the circuit board being provided with an opening through which the projected surface of the metal plate passes so that the circuit board is disposed between the imaging device and 20 the metal plate when the former is secured to the latter.

That is, an imaging device block is assembled in advance by the imaging device, the circuit board and the metal plate, and the device block is to be mounted as one unit on the optical unit, so that productivity can be 25 increased.

In one embodiment, the flat surface is provided with an opening corresponding to the at-least-one opening of the projected surface, and the projected surface comprises the top surface of a wall portion formed to surround the 5 opening of the flat surface.

Preferably, the projected surface includes the top surface of a portion protruded from the flat surface of the metal plate, and the opening of the circuit board is set to be larger than that of the protruded portion of the metal 10 plate but smaller than that of the imaging device. The protruded portion may comprise a quadrilateral wall portion, and the opening of the circuit board may be of a square shape.

15 Brief Description of the Accompanying Drawings

Fig. 1 is a front perspective view of a solid-state imaging device block embodying the present invention;

Fig. 2 is a rear perspective view of the device block 20 shown in Fig. 1;

Fig. 3 is a perspective view of the device block cross-sectioned along the line L-L in Fig. 1;

Fig. 4 is an enlarged perspective view of a metal plate of the device block of Fig. 1;

25 Fig. 5 is an exploded perspective view of the device

block mounted on an optical unit;

Fig. 6 is a perspective view of a modified metal plate; and

Fig. 7 is a cross-sectioned perspective view of the 5 device block employing the modified metal plate.

#### Description of the Embodiments

10 Figs. 1 through 3 show a solid-state imaging device block 10 embodying the present invention to be mounted on an optical unit 100 (see Fig. 5) of a digital camera.

The device block 10 comprises a CCD 1 having more than 2 million pixels, a metal plate 2 for anchoring the CCD 1 15 to the optical unit 100, and a flexible printed circuit board 3 arranged between the CCD 1 and the metal plate 2.

The metal plate 2 is provided with, as shown in Figs. 3 and 4, a positioning hole 23 $\alpha$ , an oval hole 23 $\beta$  and three screw holes 24 as well as a square opening 21. The square 20 opening 21 is surrounded by a quadrilateral wall portion 22 protruded from the flat surface 25 of the metal plate 2 to face the optical unit 100. The height of the wall portion 22 is set to be larger than the thickness of the printed circuit board 3, and the top surface 22a of the wall 25 portion 22 is set to be parallel to the flat surface 25 of

the metal plate 2.

The flexible printed circuit board 3 is to electrically connect the CCD 1 with an image processing circuit, not shown, or the like to transmit the electric 5 signal generated at the CCD 1 thereto. The circuit board 3 is provided with, as shown in Figs. 4 and 5, a square opening 31, a positioning hole 33 $\alpha$  and an oval hole 33 $\beta$  corresponding to the square opening 21, the positioning hole 23 $\alpha$  and the oval hole 23 $\beta$  of the metal plate 2, 10 respectively. The opening 31 is set to have the size larger than the wall portion 22 of the metal plate 2 but smaller than the CCD 1.

The CCD 1 is anchored to the flat surface 22a of the wall portion 22 of the metal plate 2 so as to fully cover 15 the square opening 21 of the metal plate 2 while holding the flexible circuit board 3 therebetween. The CCD 1 adhered to the metal plate 2 is then electrically connected with the circuit board 3 by soldering.

In the above embodiment, the metal plate 2 is employed 20 to support the CCD 1 since the metal plate 2 is of high stiffness, high dimensional stability against the changes of temperature and humidity, and machinability with high accuracy. Further, the metal plate 2 has a high heat conductivity so that the heat generated by the CCD 1 can be 25 well absorbed and radiated, and the deterioration in image

quality due to dark current in the CCD 1 can be suppressed. In this embodiment, a plate made of aluminum is employed as the metal plate 2, and the top surface 22a of the wall portion 22 is so machined as to be parallel to the flat 5 surface 25 of the metal plate 2 with high accuracy.

The optical unit 100 on which the imaging device 10 is to be mounted is provided with, as shown in Fig. 5, a square opening 101, a pair of positioning holes 103 $\alpha$  and 103 $\beta$ , and three threaded holes 104 corresponding to the 10 square opening 21, the positioning hole 23 $\alpha$ , the oval hole 23 $\beta$  and the three screw holes 24 of the metal plate 2, respectively.

Next, how to assemble the imaging device block 10 carrying the CCD 1 as well as how to mount the assembled 15 block 10 on the optical unit 100 will be explained by referring to Fig. 5.

First of all, the metal plate 2 is held by a jig, not shown, and the flexible printed circuit board 3 is overlapped to the metal plate 2 with the wall portion 22 of 20 the metal plate 2 passing through the square opening 31 of the circuit board 3. The CCD 1 is held by other jig, not shown, and moved toward the top surface 22a of the wall portion 22 of the metal plate 2 by means of the other jig until a backside flat surface of the CCD 1 intimately and 25 opposingly abuts the top surface 22a with holding the

circuit board 3 between the flat surface 25 of the metal plate 2 and the CCD 1. The position of the CCD 1 relative to the top surface 22a of the wall portion 22 in the direction perpendicular to the optical axis is adjusted,

5 while observing the imaging surface by an optical device, not shown, so that the imaging surface comes to a predetermined position. Under the state shown in Fig. 2, the backside flat surface of the CCD 1 can be seen through the opening 21 when viewed from a backside surface 26 of

10 the metal plate 2.

After positioning of the CCD 1 in the direction perpendicular to the optical axis is completed, an ultraviolet-curing adhesive is applied, as illustrated in Figs. 2 and 3, to the corner edges of L-shaped section 15 formed by the inner circumferential surface of the square opening 21 of the metal plate 2 and the backside flat surface of the CCD 1 contacting the wall portion 22 of the metal plate 2. The applied adhesive is then exposed to ultraviolet light to be hardened, thereby anchoring the CCD

20 1 to the metal plate 2.

When applying the adhesive, it should be prevented that the adhesive penetrates between the top surface 22a of the wall portion 22 of the metal plate 2 and the contacting surface of the CCD 1, because the CCD 1 may be tilted with

25 respect to the metal plate 2 by the penetrated adhesive. In

this connection, it is preferable to employ the ultraviolet-curing adhesive having the viscosity of 1 - 30 Pa·s, and more preferably 17 - 27 Pa·s.

Once the CCD 1 is anchored to the wall portion 22 of 5 the metal plate 2, the flexible printed circuit board 3 is surely held between the metal plate 2 and the CCD 1 and may not be removed therefrom, as the wall portion 22 of the metal plate 2 secured to the contacting surface of the CCD 1 passes through the square opening 31 of the circuit board 10 3.

Then, the precise positioning of the circuit board 3 with respect to the metal plate 2 is performed by passing a pair of pins 4 through the positioning holes 23a & 33a and the oval holes 23b & 33b, respectively. Since the posture 15 of the circuit board 3 is primarily regulated by the wall portion 22 of the metal plate 2, the precise positioning can be performed very easily. Thereafter, lead wires, not shown of the CCD 1 are soldered to the corresponding parts of the circuit board 3 so as to electrically connect the 20 CCD 1 to the circuit board 3.

With this, assembling of the imaging device block 10 is completed.

The thus assembled imaging device block 10 carrying the CCD 1 is moved toward the optical unit 100 by means of 25 the jig supporting the metal plate 2 of the block 10 until

the CCD 1 of the block 10 contacts the optical unit 100. While the block 10 is approaching the optical unit 100, the pair of pins 4 whose front ends are outwardly protruded from the block 10 with passing through the metal plate 2 5 and the circuit board 3 are to be inserted into the positioning holes 103 $\alpha$  and 103 $\beta$  of the optical unit 100, respectively, whereby positioning of the block 10 with respect to the optical unit 100 can be automatically performed so that the CCD 1 of the block 10 is surely fit 10 into the square opening 101 of the optical unit 100.

Thereafter, three screws 5 are threaded into the threaded holes 104 of the optical unit 100 through the corresponding screw holes 24 of the metal plate 2 of the block 10, respectively, to securely mount the block 10 onto 15 the optical unit 100.

With the above explained structure for mounting a solid-state imaging device (i.e., the CCD 1) embodying the invention, as the CCD 1 is secured to the metal plate 2 with high positioning accuracy to constitute the imaging 20 device block 10, and the imaging device block 10 is to be mounted as a unit on the optical unit 100, tilting and/or floating of CCD with respect to and/or from the glass-epoxy board, which have been occurred in the conventional structure, due to soldering, can be prevented. Further and 25 therefore, mounting of CCD on the optical unit with high

positional accuracy can be performed easily with efficient workability.

In the meantime, in the above-mentioned embodiment, the size of the square opening 31 of the flexible printed circuit board 3 is set to be larger than that of the wall portions 22 of the metal plate 2, but it may be set to be substantially equal to each other so that the posture of the circuit board 3 is more strictly regulated with respect to the metal plate 2.

10 On the contrary, the opening 31 may be formed fairly  
larger than that of the wall portions 22 of the metal plate  
2. In this case, the shape of the opening 31 may be freely  
determined so far as the lead wires of the CCD 1 can be  
connected thereto.

15 Moreover, as shown in Figs. 6 and 7, the top surface  
22a of the wall portions 22 on the metal plate 2 may be  
extended to fully cover the square opening 21, and a  
plurality of holes (openings) 21a are to be formed on the  
extended top surface, for pouring the ultraviolet curing  
20 adhesive thereinto to anchor the CCD 1 thereto.

The present disclosure relates to the subject matter contained in Japanese Patent Application No. 2000-019419, filed on January 28, 2000, which is expressly incorporated herein by reference in its entirety.